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The feasibility of manufacturing wind turbines in Iran

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Abstract

It is known that the supplies of fossil fuels are limited and their utilization as energy sources causes environmental degradation due to incomplete combustion when used as energy source, in addition to this as the world population increases the demand for energy sources increases, therefore the issue of a gradual replacement of fossil fuels with renewable energy sources is of major consideration for most countries: Iran Bing located in Asian Middle East enjoys a great potential for producing some 6500 MW of electricity with wind energy. The feasibility of manufacturing wind turbines is investigated in this article.

Keywords: Wind turbines; Renewable energy; Feasibility

Contents

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1. Introduction

Iran's geographical situation is such that its low air pressures in comparison with high pressures in the north and northwestern regions produce strong air flows over it in general during the summer and winter months. During the winter months it is the difference in the air pressure between the atmosphere over Iran, center Asia as well as the Atlantic Ocean that causes cold winds from north and humid air flows from the Atlantic and Mediterranean from west. When these systems of air maldes collide with the humid air from the Mediterranean, cools off Iran producing snow over the country. During the summer Iran is also affected by winds from the Atlantic Ocean on the northwest and by the winds from the Indian Ocean from the southeast; of the well known winds from the east are the 120 day winds of sistan and lavas wind: the other local winds in the country include the north winds on the Persian golf and Khoch a bad winds in the Gorgan plain, deez wind between Mashad and Nayshabour and sham winds in Khuzestan!

On the other hand, this country situated in middle east Asia is rich in fossil fuel supplies such as oil, gas, etc. which make up the basis of its national economy and taking into account the population growth rate energy consumption is quite substantial which could possibly cut down the export rates of fossil fuels. Utilization of renewable energy sources in Iran began a decade ago and it is still in its initial stages of development. In this article, the feasibility of manufacturing wind turbines to take advantage of wind power is discalced and first the subject of wind power and wind propelled stations in the world and in Iran is considered. Then the required technology and the possibilities of manufacturing wind turbines in Iran are evaluated and the costs are compassed with those manufactured.

2. The power of wind on the surface the earth

The energy potential for wind at a height of 10 m from the surfaces of the earth is shown in Fig. 1. This picture shows the wind energy ranging between 200 and 400 W/m in the world. It can be seen that wind energy is greater in the northern hemisphere and it's highest level is in Europe and North America [1].

2.1. Electric power from wind energy

Renewable energy sources include water, wind, geothermal, solar, etc. Table 1 shows the extent of utilization of wind energy for producing electricity in comparison with the use of other renewable energy sources [2]. It can be seen that of the 2800 billion kW h of energy utilized more come from hydroelectric sources. Wind energy with a total power of 13,500 MW produces about 23 billion kW h of electricity ranks third among the renewable energy sources [3].

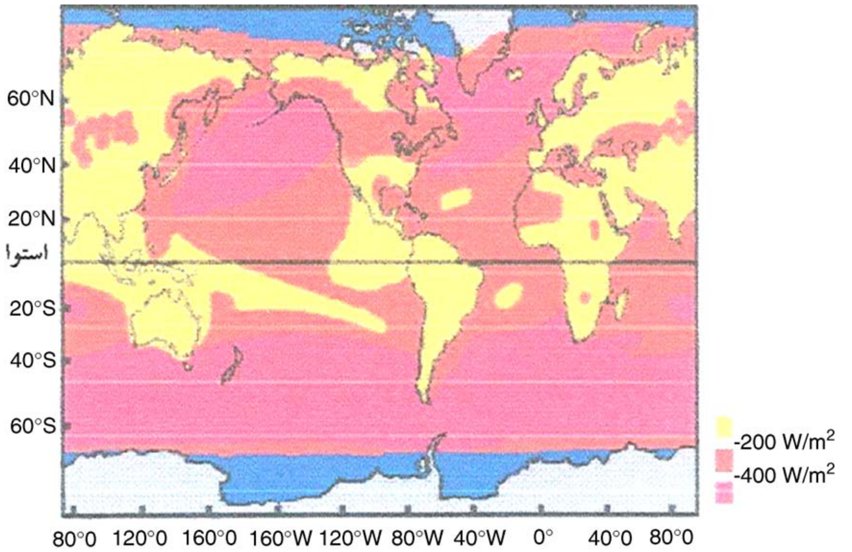


Fig. 1. Average wind power at a height of 10 m from the surface of the earth [1].

Table 1
The annual figures for electricity production from renewable energy sources world wide [2]

Order number	Source of energy	Power (MW)	Energy (billion of kW h)
1	Water	669,000	2690
2	Geothermal	7900	49
3	Wind	13,500	23
4	Solar	325	0.9
5	Photovoltaic	700	0.7
6	Total	700,000	2800

3. Potential energy of wind in Iran

The potential energy of wind is estimated to be about 6500 MW in Iran. As a matter of fact this level of energy is considered to be of medium level among different countries, however, some locations in Iran are subjected to have strong winds to produce electricity. The average wind velocity in such location equals 5 m/s in the eastern parts (Fig. 2).

3.1. Utilization of wind power for electricity generation in Iran

Scientists and researchers began working on utilization of wind energy for electricity generation in Iran a decade ago. Loading in to the construction of the first wind powered electricity generation, the rate of electricity production and the number of wind turbines are recorded in Table 2 [4].

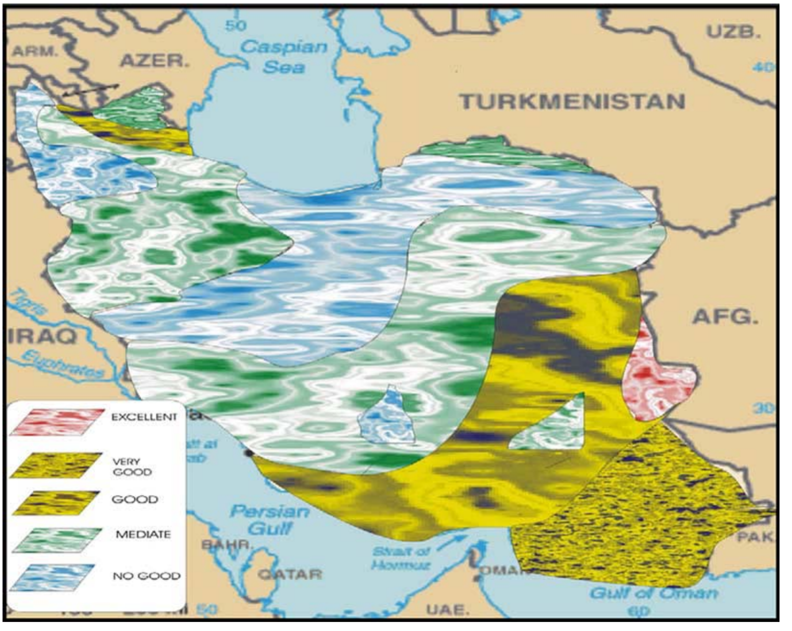


Fig. 2. Approximate map of wind currents in Iran at a height of 25 m for seventies.

Table 2
The number of wind turbines and the rate of electricity generation in Iran

Order number	Year	Number of operating wind turbines	Electric power (GW h)
1	1994	2	0.14
2	1995	2	4
3	1996	2	4
4	1997	11	6.3
5	1998	25	18.5
6	1999	27	36.2
7	2000	27	33.8
8	2001	27	33.6

As can be seen from Table 2 some 34 GW h of electricity was produced in 2001 from the first wind power station.

3.2. The development of wind propelled station in Iran

Considering the good potential of well situated location, construction of the wind power stations began in 2003 in Iran.

Including:

(A) The 25 MW power station at Manjiel.
(B) The 60 MW power station at Manjiel.

4. Required technology for constructing wind turbines in Iran

The demand for electricity will be at least double the current rate to equal 30,000 MW by 2015 in Iran. Obviously, this amount of energy cannot only be produced with fossil fuels that are running out. At the present time most developed countries, which have wind energy potential similar to those in Iran are taking advantage of this power at an accelerating rate. Currently more than 23 billion kW h of cheap, clean and development sources electricity are being produced annually across the world. Germany, for example, produced some 4400 MW of electricity with wind. While Iran with a similar level of available wind power produces only 10 MW. The related figure for India, neighboring country, is 1000 MW [5].

Taking these developments into consideration, Iran is also making efforts in using renewable energy sources including wind. Since a large number of wind turbines are needed the feasibility of manufacturing them is evaluated here.

4.1. Evaluation of the feasibility of manufacturing the main components of a wind turbines in Iran

Table 3 shows the feasibility of manufacturing large and small component of wind turbines in the country [6–8]. As can be seen there is a possibility of manufacturing small

Table 3
The feasibility of manufacturing or technology transfer for making main components of large and small wind turbines in Iran

Section	Type of turbine	% Feasibility of making in Iran	% Need for technology transfer
Generator	Small	100	0
	Large	20	80
Propellers	Small	100	0
	Large	15	85
Gear box	Small	–	–
	Large	0	100
Nose ball bearing	Small	95	5
	Large	25	75
Electrical control system	Small	80	20
	Large	20	80
YAW systems	Small	100	0
	Large	10	90
Tower a foundation	Small	100	0
	Large	100	0
Transformer	Small	–	–
	Large	100	0
Mechanical connections	Small	100	0
	Large	80	20
Design	Small	90	10
	Large	20	80
Assembling in factory	Small	100	0
	Large	30	70
Battery	Small	100	0
	Large		

Table 4
Cost estimates for manufacturing 10 kW h turbines in Iran as composed with those in other countries

Component name	Description	Price
Generator	Including devises for stability Frequencies a generator controls	4375
No. 33 be at nose parts	H.P composite	3750
Propellers	H.P composite	5000–6250
Tower	Self support + anchored in different grid bike and telescopic up to 26 M	2875–5625
Mechanical devices		3125
Foundation		375
Parts and installation	Gifting and installation in an hour cost	3125
Transportation and other		1250
Capital investment + design	Software-design accounting	%25 of the above costs

Prices are given in terms of a currency rates.

Table 5
A composition between finished 10 kW Iranian made turbines and an imported one including transportation and installation costs (US$)

Iranian made turbines 29,840–34,840	Imported turbines 34,000–55,000
Iranian made battery (extraneous parts) 7500	Imported battery 16,800
50,800–71,800	37,340–42,340

wind turbines (10 kW or smaller) in Iran where they are especially needed for the following reasons:

1. Application in places isolated from the national power network given large area of Iran.
2. Prevention of voltage fluctuation by using several small turbines.
3. Savings in expedients for transportation, installation and start up with such facilities.
4. Better sights compatible with maturely beauty.
5. Simple technology in comparison with designs and features used for larger turbines.

4.2. Economic feasibility

Table 4 shows the prices of small wind turbines manufacturing by companies in Iran. As can be seen a complete 10 kW h turbines will cost about 29,840$ including transportation costs. In addition to the cost of turbines itself, about 7500$ are needed for a 440 A h 220 V battery (without installation and other changes). Table 5 lists the prices of 10 kW h turbines made here and those imported. As can be seen Iranian made turbines cost less [9].

It is noteworthy that as the sage of turbines increase the relative costs of manufacturing them decreases.

5. Conclusions

Some 3–5% of the Iranian population or about 3,250,000 people are still without the services of electric power in Iran. These people live in some 43,200 village of power then 20 families.

Taking into account villages in well situated areas, 1300, 10 kW wind turbines will be needed. Considering the possibilities of manufacturing them in Iran, the demand for electricity in isolated places will be met and money will be saved with lower costs of locally made turbines as well as gains in employment and technical know-how for the country.

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